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Abstract Title (write here)

Summary. This paper relates design parameter variability of thermoplastic honeycomb sandwich beams to their experimentally determined dynamic behaviour in case of free boundary conditions. This paper describes how two independent elastic material properties are chosen as design parameters of interest, treated as Random Fields, are linked to frequency response function variability.

Abstract:

Honeycomb panels are sandwich structures with a high specific strength and stiffness, together with a low areal mass. They are complex but regular structures with a high number of design parameters that govern their dynamic behaviour.

A first part of this paper gives an overview of the various design parameters that govern the dynamic behaviour of freely suspended Thermoplastic Honeycomb beams with a glass fibre reinforced skin. The considered dynamic behaviour of the honeycomb sandwich beams is in fact a stochastic process, governed by a set of parameters, each having some kind of randomness. By means of a suitable Finite Element model two independent elastic material properties are selected from the total set of design parameters, namely the Young's modulus of the skin in length direction and the out of plane core shear modulus. These two parameters are important factors in governing the resonance behaviour of the considered honeycomb sandwich beams. The goal of this paper is to describe the relation between the variability of these material constants and the experienced variability in the Frequency Response Functions at 17 measurement points on each beam sample. These functions are experimentally determined for a set of 22 honeycomb samples.

The variability of the two material constants is split into alleatory and epistemic uncertainty. Alleatory uncertainty arises from the inherent physical variability of the design parameters of interest. Epistemic uncertainty arises from the fact that only limited experimental data is available for a statistical evaluation. Therefore these independent parameters are considered as Random Fields. Each Random Field is described in terms of a Karhunen – Loève series expansion with a Polynomial Chaos decomposition of its random coefficients. The physical realisations of these Random Fields are the quantities of these two parameters at the 17 measurement points. The inverse problem to determine these realisations is solved by means of a direct model updating of the Finite Element model using the measured Frequency Response Functions.

The paper outlines the implementation of the Random Field method along with its extension to estimate the epistemic uncertainty.

The errors that occur during the whole process of Experimental Modal Analysis may lead to a certain variability which is not physically related to the design parameter variability of interest. The way how this is addressed in the study is also outlined in the paper.

As a result of this study the unknown probability distributions of two important design parameters at the 17 considered measurement locations are estimated, including an estimation of the uncertainty due to the lack of sufficient statistical data.

Topics:

Thematic Sessions: Processing and Fabrication of Advanced Composite Materials (Shankar. Kalyanasundaram)

Personal Keywords: Thermoplastic honeycomb beams, experimental modal analysis, finite element modelling, design parameter variability, Random Fields.